of the cerebral motor areas, therefore, does not exercise a definite inhibitory action upon reflexes, but does under certain conditions markedly increase them, one might expect that their removal would diminish reflex action. Such a diminution actually occurs when they are destroyed in disease, but when the brain is removed layer by layer in operations upon animals, it is usually found that the reflex increases in proportion to the quantity removed. When the whole brain is removed, the reflex action is greater than when it is present, and as the cord is cut away layer by layer, the excitability of the segment below appears to be increased; each layer, as has already been mentioned, appearing to have an inhibitory influence on the one below it. But this is not always the case, because we sometimes find on removal of the various parts of the brain or of the spinal cord that the section completely abolishes reflex action for the time.

We are accustomed frequently to cloak our ignorance of the true cause of this abolition by saying it is due to the shock of operation or something of that sort; but looking the facts fairly in the face, we find that sometimes removal of the upper part of the brain or spinal cord causes increase and sometimes diminution of reflex-action in the parts below. At present we have no satisfactory explanation of this phenomenon, but if we suppose in the one case the nervous matter to have been removed in such a way as to cause an interference of the stimuli passing along from cell to cell, and in the other to cause a coincidence, we can readily understand the occurrence of the two different conditions. Moreover, we have said several times, that inhibition or stimulation are only relative conditions depending on the length of path along which the stimulus has to travel, and the rapidity with which it travels. The length of path remaining the same, the occurrence of stimulation or inhibition depends upon the rapidity of passage of the stimulus. The same length of path which is just sufficient to throw successive impulses of a slowly travelling stimulation half a wave-length behind the other, and produce inhibition, may be just sufficient to throw the vibrations of another more rapidly transmitted stimulus a whole wave-length behind, and produce increased instead of diminished action.

If the hypothesis that inhibition is produced by interference be true, we shall be able to test it by seeing whether stimulation of certain nerves which, under the ordinary conditions produce inhibition, do so when the rate of transmission of nervous impulses is altered. The length of path being the same, if we alter the rapidity of transmission it is probable that as the rapidity diminishes, the inhibition will be converted into stimulation, again possibly passing into inhibition, according as the stimuli, which we normally suppose to be half a wave-length behind each other, are thrown a whole wave-length, or a wave-length and a half behind each other. At a certain period, also, the waves of stimulation will be neither a whole nor a half wave-length behind each other, but the fraction of a wave-length. In such cases we shall neither have constant coincidence, nor constant interference, but we shall have rhythmical coincidence and rhythmical interference, the result of which will be that we shall neither get constant motion, nor constant arrest of motion, but alternate motion and rest. In other words we shall neither have complete rest nor tonic contractions, but intermittent or clonic contractions. Now this condition is exactly what we do find when one sciatic of a frog is irritated twenty-four hours after it has been exposed. We have already mentioned that when irritated immediately after exposure it had the effect simply of abolishing reflex action in the other leg; but the same irritation applied in the same manner after many hours, instead of causing arrest in the other leg, causes clonic convulsions.[1]

This occurrence is very hard to explain on the ordinary hypothesis of separate and distinct inhibitory centres, but it agrees perfectly with the hypothesis that inhibition and stimulation are merely relative conditions.

I have repeated Nothnagel's experiments, but I have not got the same results. Irritation of the sciatic nerve indeed caused a certain diminution in reflex at first, but irritation after twenty-four hours caused no clonic convulsions, it merely appeared somewhat to stimulate reflex action in the other leg. The reason of this discrepancy in our results is probably that the temperature was different in the two cases. Nothnagel's results were published in March, and his experiments were probably performed during cold weather, while mine were done during very mild weather. If the effects which he noticed were due to definite inhibitory centres in the spinal cord similar experiments should have had similar results in his hands and mine If on the other hand the effects simply depend on the rate of the transmission of nervous impulses it is easy to understand why the results were different in the two cases.

There are also certain phenomena connected with the action of drugs on the spinal cord which are almost inexplicable on the ordinary hypothesis, but which are readily explained on that of interference. Thus belladonna when given to frogs causes gradually increasing weakness of respiration and movement, until at length voluntary and respiratory movements are entirely abolished, and the afferent and efferent nerves are greatly weakened. Later still, both afferent and efferent nerves are completely paralysed, and the only sign of vitality is an occasional and hardly perceptible beat of the heart and retention of irritability in the striated muscles. The animal appears to be dead, and was believed to be dead, until Fraser made the observation that if allowed to remain in this condition for four or five days, the apparent death passed away and was succeeded by a state of spinal excitement. The forearms passed from a state of complete flaccidity to one of rigid tonic contraction. The respiratory movements reappeared; the cardiac action became stronger, and the posterior extremities extended. In this condition a touch upon the skin caused violent tetanus usually opisthotonic, lasting from two to ten seconds, and succeeded by a series of clonic spasms. A little later still the convulsions change their character and become emprosthotonic. These symptoms are due to the action of the poison upon the spinal cord itself, for they continue independently in the parts connected with each segment of the cord when it has been divided.

This action may be imitated by a combination of a paralysing and exciting agent such as strychnia and methyl-strychnia. Fraser concludes that the effects of large doses of atropia just described are due to a combined stimulant and paralysing action of the substance on the cord, and that the difference in the relations of these effects to each other, which are seen in different species of animals, may be explained by this combination acting on special varieties of organisation.

T. LAUDER BRUNTON

(*To be continued.*)

NOTES

THE Queen has signified her intention of opening the International Fisheries Exhibition, at South Kensington, on Saturday, May 12.

BARON NORDENSKJÖLD writes to us that he has definitely settled to start for the interior from Auleitsivik Fjord on the west coast, and then, in September, to go round Cape Farewell along the east coast to the north.

A MOST interesting letter has been received at Kew Observatory from Mr. Cooksley, of Capt. Dawson's expedition to Fort Rae. They arrived on August 30, started the meteorologica observations on September 1, and the magnetical observations on September 3. Apparently all was well at the date of the letter, December 19, 1882.

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[1] Nothnagel, Centralblatt f. d. med. Wiss. March 28, 1869, p. 211.

Mr. William Henry M. Christie, F.R.S., Astronomer Royal, has been elected by the Committee to be a Member of the Athenæum Club, under Rule 2, which provides for the admission of persons distinguished in literature, science, or the arts, or for public services.

M. Dumas was not able to be present at Monday's sitting of the Academy of Sciences. His recovery is not quite so rapid as it was hoped and expected to be.

In the Civil Service Estimates for 1883-4 the total vote for education, science, and art amounts to £4,748,556, a net increase of £165,531 over the previous year.

The sixth International Congress of Orientalists will be opened at Leyden on September 10 next.

Mr. Milne, who has recently returned to his post in Japan, has suggested to the Japanese Government the great utility of establishing a series of observations for the study of earthquakes; earth-tremors; earth-pulsations; earth-oscillations, or permanent changes of level; terrestrial magnetism; fluctuations of underground water; earth temperatures; eruptive phenomena, &c. We trust that the Japanese Government will see it to be their interest, in a land of earthquakes, as well as the interest of science, to take the advice of Mr. Milne, who has already done so much for seismology. Mr. Milne writes that he is more and more convinced that there are "earthquakes" of so slow period that neither observers nor ordinary instruments record them. The Japanese papers report that a volcano in the Asuma Yuma range has burst out.

Mr. A. H. Keane has been elected Corresponding Member of the Italian Anthropological Society.

Mr. Robert Lindsay has been appointed Curator of the Edinburgh Botanic Garden.

A special general meeting of members only of the Association for the Improvement of Geometrical Teaching will be held at 8 p.m., on March 20, at University College, (1) to authorise the publication of Books i. and ii. of the Elementary Geometry as revised by the committee; (2) to appoint three trustees of the property of the Association.

The Institution of Naval Architects began its annual meeting yesterday, and continues to-day and to-morrow. Among the papers in the programme are the following:—On certain points of importance in the construction of ships of war, by Capt. G. H. Noel, R.N.; The influence of the Board of Trade rules for boilers upon the commercial marine, by J. T. Milton; Sea-going torpedo-boats, by M. J. A. Normand; Some experiments to test the resistance of a first-class torpedo boat, by A. F. Yarrow; On the modes of estimating the strains to which steamers are subject, by Wigham Richardson; On the extinctive effect of free water on the rolling of ships, by P. Watts; A description of a method of investigation of screw propeller efficiency, by H. B. Froude; The speed and form of steamships considered in relation to length of voyage, by James Hamilton; On fog-signalling, by J. MacFarlane Gray; Method of obtaining the desired displacement in designing ships, by R. Zimmermann.

The Royal Commissioners for Technical Education—Messrs. Samuelson, M.P., Woodall, M.P., P. Magnus, and Swire Smith—accompanied by Mr. G. R. Redgrave (secretary), visited Birmingham on March 8, and devoted several days to a careful inspection of the Mason College, Midland Institute, &c. The Commissioners were much interested in the system of practical science instruction which is being carried on in the Board Schools under the direction of Mr. Jerome Harrison, F.G.S., and both heard lessons given in the new Icknield Street Schools, and examined the newly built laboratory, &c. We hope shortly to present to our readers an account of the system by which about 2500 of the elder boys and girls in the Birmingham Board Schools are now receiving lessons in elementary science, at, practically, little or no extra cost to the town of Birmingham.

It is proposed to establish the new Professorship of Physiology at Cambridge in the ensuing Easter term. The appointment of a Professor of Pathology is also declared by the General Board of Studies to be urgent. The Medical Board has recently unanimously reported that the appointment of a Professor of Surgery is urgently necessary; and Prof. Humphrey has offered to resign the Professorship of Anatomy and accept the Professorship of Surgery for the present, without stipend.

The death is announced of William Desborough Cooley, the author of a History of Geographical Discovery, a Physical Geography, and other geographical works, and who at one time wrote largely on theoretical African geography.

The half-yearly General Meeting of the Scottish Meteorological Society will be held to-day. The business before the meeting is: (1) Report from the Council of the Society; (2) Address by Prof. Piazzi Smyth, at request of the Council, on Rainband Spectroscopy; (3) the Meteorology of Ben Nevis in 1882, by Clement L. Wragge.

The *Réforme*, the new Paris paper, which has established telegraphic communication with London, publishes daily a translation of the previsions issued by the Meteorological Board of London, which is read by the French public at the same time as in England.

M. Lalanne, Member of the Academy of Sciences, has been elected a Life Senator in the Liberal interest. It seems to be becoming almost a constant practice of the French Senate to select its "Irremovables" from among the several classes of the Institute.

An Electrotechnical Society has been formed at Vienna, similar to the one existing and flourishing at Berlin.

The German astronomers who had proceeded to Punta Arenas in Magellan's Straits in order to observe the last transit of Venus have at last returned to Germany.

A meteoric stone weighing a hundredweight fell near Alfianello, near Brescia, on February 16 last. It entered the ground to a depth of two metres, and caused a shock like that of a slight earthquake.

A memoir, for which a gold medal (600 francs) has been awarded by the Belgian Academy, is by Prof. Fredericq, of Liege; it is on the influence of the nervous system on the regulation of temperature in warm-blooded animals. After many experiments, the author affirms that cold acts on the sensitive nerves of the skin, and through them on centres of thermogenesis in the *medulla oblongata*. These centres react, and through centrifugal nerves cause an increase of the phenomena of interstitial combustion, especially in the muscles; but we also fight with cold by a diminution of the losses of heat, the vessels of the skin being constricted, owing to an excitation of the vaso-constrictor centres, through impression of the sensitive nerves of the skin by cold. M. Fredericq considers that the system does not (as most physiologists say) contend against heat by diminishing the production of heat. The regulation of temperature is simply based on increase of the losses of heat, by dilatation of the cutaneous vessels, by acceleration of the outer circulation, increased secretion and evaporation of sweat, and greater admission of air to the lungs. The vaso-dilator nerve centres (sudorific and respiratory) are excited directly by superheated blood.

An interesting trial of an electrically-moved tramcar took place on Monday at Kew, and, notwithstanding some inevitable hitches, may be regarded as fairly successful. The peculiarity of the application of electricity in the present case lies in the use made of accumulators. The car was constructed at the Electrical Power Storage Company's works at Millwall, and is of the usual dimensions for carrying forty-six inside and outside passengers. It weighs, with its accumulators and machinery, but without any passengers, four and a half tons. Under the inside seats of this tramcar is placed the accumulator, consisting of fifty Faure-Sellon-Volckmar cells, each measuring 13 inches by 11 inches by 7 inches, and each weighing about 80 lbs. This accumulator, when fully charged, is capable of working the tramcar with its maximum load for seven hours, which means half a day of tramway service. From the accumulators the current is communicated by insulated wire to a Siemens' dynamo placed underneath the car, which acts as a motor, the motion being transmitted to the axle of the wheels through a driving-belt. To start the car the current is switched on from the accumulator to the dynamo, the armature of which being set in motion, the power is communicated to the driving wheels. The car can be driven from either end, and the power required can be exactly apportioned to the work to be done by using a greater or lesser number of cells. On a level road, for instance, with a light load, only a comparatively small number of cells will be necessary, but with a heavy load or on a rising gradient greater power will be required, and additional cells must be switched in. The action of the motor, and consequently the direction of the car, can be readily reversed by reversing the current, and the car can also be as readily stopped by shutting off the current entirely and applying the handbrake with which the car is fitted. At night the car is lighted by means of four Swan incandescent lamps, two of which are placed under the roof and one at each end of the car. All the lamps derive their current from the accumulator. The car is also fitted with electric bells, worked from the same source, and is to be run regularly on the Acton tramway line. The Storage Company also had a successful trial on Monday at Kew of a launch fitted with a battery of forty cells and a Siemens' dynamo.

We learn from the last number of the *Journal* of the Russian Chemical and Physical Society (1883, fascicule 1) that, at a recent meeting of the Society, Prof. Mendeléeff made a communication on the applicability of the third law of Newton to the mechanical explanation of chemical substitutions, and especially to the expression of the structure of hydrocarbons. If we admit not only the substitution of hydrogen by methyl, but also the substitution of CH_2 by H_2, and of CH by H_3—as must be according to the law of substitutions as deduced from the third law of Newton—we can not only explain, but also predict, all cases of isomerism, without recurring to the usual conceptions as to the connections and atomicities of elements. Thus, benzene can be understood as a normal butane, $CH_3CH_2CH_2CH_3$, or $(CH_3CH_2)_2$, where a double symmetrical substitution of H_3 by CH has taken place, the H_2 having been taken from CH_3 and the third H from CH_2, so that only the CH groups are left; benzene being thus $= \begin{pmatrix} CHCH \\ CH \end{pmatrix}^2$. It would explain the isomer of benzene, dipropargyl the formation from acetylene, and the substitution and addition products from benzene.

The additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus erythræus* ♂) from India, presented by Mr. C. F. Henshaw; a Grey Ichneumon (*Herpestes griseus*) from India, presented by Mr. F. C. H. Dadswell; a Herring Gull (*Larus argentatus*), British, presented by Miss Ella Vicars; three Common Swans (*Cygnus olor*), British, presented by Mr. J. Hargreaves; four Prairie Grouse (*Tetrao cupido*) from Iowa, North America, presented by Mr. Henry Nash; a Daubenton's Curassow (*Crax daubentoni* ♀) from Venezuela, presented by Mr. Rowland Ward, F.Z.S.; a North American Turkey (*Meleagris gallo-pavo* ♂) from North America, presented by His Grace the Duke of Argyll, K.T., F.R.S.; a Malbrouck Monkey (*Cercopithecus cynosurus*) from West Africa, deposited; a Gaimard's Rat Kangaroo (*Hypsiprymnus gaimardi* ♀), three Coypu Rats (*Myopotamus coypus*), born in the Gardens.

GEOGRAPHY OF THE CAUCASUS

Of the several branches of the Russian Geographical Society, the Caucasian and the East Siberian are well known for the amount of valuable geographical work they have done during the thirty years or so of their existence. The high scientific interest connected with the exploration of the Caucasus is obvious. The scientific exploration of the Alps has revealed to us a new world; but the highlands of the Caucasus, with the high plateaux of Trauscaucasia, afford a still greater variety of geological and physico-geographical features than the Alps; besides, situated as they are on the boundary between the moist climate of the west and the dry one of the east, between the deeply-indented coasts of Europe and the deserts and plateaux of Asia, between the young civilisations of the west and the old civilisations of the east, the Caucasian highlands afford such a variety of climatic, botanical, zoological, and ethnological features as hardly can be met with in any other country of the world. Very much remains to be done to bring these highlands within the domain of scientific knowledge. In what has been done up to the present, the Caucasian branch of the Russian Geographical Society has always had a good share, either by direct exploration, or by bringing to the knowledge of the scientific world such explorations as otherwise would have remained unknown in the archives of different Government offices, or by giving a scientific character to such explorations as were made for military or diplomatic purposes. Besides, the activity of the Caucasian Geographical Society is not limited to the Caucasus. Closely connected with the General Staff of Tiflis, it extends its explorations to the Trans-Caspian region, to Asia Minor, and to Persia; and closely follows the Russian military expeditions, surveyors, and diplomatists who eagerly visit these countries.

Unfortunately the publications of the Caucasian branch—the *Zapiski* or *Memoirs*, and the *Izvestia* or *Bulletin*—are but very insufficiently known abroad, *Petermann's Mittheilungen* being nearly the sole channel through which they are brought to the notice of the scientific world. The following summary, therefore, of the last publications of the Society will be of some use to scientific geographers. Without attempting to review all the volumes of the *Memoirs* and *Izvestia* which have appeared, we shall limit this paper to a review of the two last of each, the chief results of the papers contained in former volumes being already embodied in Elisée Reclus's "Géographie Universelle."

Several papers of the sixth volume of the *Izvestia* are devoted to the geodesy of the Caucasus and adjacent countries. During the war of 1878 a considerable amount of geodetical work was done in the province of Kars and in Asia Minor, and M. Kulberg gives the latitudes and longitudes determined. The longitudes of Kars, Erzerum, and Mysun were determined by means of telegraphic signals (the accuracy of this method being such as to reduce the probable error between Pulkova and Vladivostok, on the Pacific, to 0″·14, that is, to 50 yards on a distance of 7000 miles). Other longitudes were determined by chronometer. A trigonometrical network was extended to Erzerum, and numerous surveys were made. The longitudes of several points at Constantinople were determined with great accuracy by General Stebnitzky, as well as that of Batum by M. Kulberg.

The same volume contains also a list of latitudes and longitudes determined on the banks of the Emba and on the Mangishlak peninsula.—M. Kulberg contributes also an interesting paper on the results of determinations of lengths of the pendulum on the Caucasus, in order to determine the increase of gravity caused by the Caucasian chain. The observations were made at